United States Participation in the 2011 Cooperative Indian Ocean Field Experiment

Prepared by
Chris Fairall (NOAA/ERSL), Richard Johnson (Colorado State University),
Michael McPhaden (NOAA/PMEL), Chidong Zhang (University of Miami)

Endorsed by the US CLIVAR MJO Working Group

Background I: Importance of the MJO/TIV
• Monsoons, ENSO, IODZM, ITF
• Teleconnections, extratropical circulation/weather
• Extreme events (midlat rainfall, tropical storm/cyclones)
• Earth’s rotation rate, length of the day
• Atmospheric and oceanic chemistry and biosystem (ozone, CO₂, aerosols, chlorophyll)
• Prediction potential (> 20 days)
Background II: Challenges
• limited intraseasonal dynamical prediction skill (< 10 days)
• inability to consistently/knowingly reproduce the MJO/TIV by global climate models
• poor understanding of the mechanisms for the MJO/TIV, especially their convective initiation
• lack of in situ observations in the equatorial Indian Ocean

Background III: MJO/TIV research recommended by
• THORPEX International Science Plan
• ECMWF, WCRP/THORPEX & US CLIVAR workshops
• Year of Tropical Convection (YOTC)
• US Climate Change Science Program (Synthesis and Assessment Product 3.3 “Weather and Climate Extreme in a Changing Climate”).
Scientific Rationale
• Convective initiation of the MJO/TIV is the least understood relative to propagation and its prediction more limited;
• Hypothesis testing (see white paper) requires continuous time series of vertical structures of convective systems and heat/moisture budgets – available only from field campaigns;
• No such time series from the equatorial Indian Ocean is available to date.

JAMSTEC commitment and international interests
• R/V MIRAI: ~ 50 days between Nov. 2011 – Jan. 1012
• seeking international participation
• international interests: Australia, US, China, India, France
The plots above are composite MJO structures based on 8 NH winter events.
The ovals - over the Indian Ocean - highlight important differences between AIRS and NCEP/NCAR vertical temperature structure. This difference is shown more concisely in the next slide.
In AIRS, a boundary-layer temperature anomaly precedes the tropospheric temperature anomaly in a somewhat consistent way for both the Indian and western Pacific Ocean. This doesn’t appear to be the case for the NCEP/NCAR results.
The above temperature profiles were taken from the composite AIRS and NCEP/NCAR MJO structures shown on the previous slide.

- The plot on the left shows the profiles over the Indian Ocean for Lag +2 pentads (disturbed) minus Lag -2 pentads (suppressed). The NCEP/NCAR profile is less consistent with the implied conditions - i.e. positive precipitation anomalies.

- The plot on the right shows the profiles over the western Pacific Ocean for Lag +4 pentads (disturbed) - Lag 0 pentads (suppressed). The AIRS data exhibit stronger boundary-layer (tropospheric) cooling (warming) compared to the NCEP/NCAR for the implied conditions - i.e. positive precipitation anomalies.
Motivation and justification for the US participation
• Benefit from improved intraseasonal-seasonal prediction (hurricanes, North American Monsoon, ENSO, mid-latitude teleconnections & their extreme weather events);
• An additional research vessel with Doppler radar capability (e.g., R/V Ron Brown) essential to the data collection – record length (up to 100 days) and constraint for the budget estimates – only available from the US.

US facilities requested:
Primary:
• A research vessel with Doppler radar capability (preferably R/V Ron Brown) for 50 days on station to rotate with R/V MIRAI
• soundings ($\geq 4$/day), air-sea flux and upper ocean measurement

Others (to be specified):
• Enhancement of RAMA
• measurement onboard of the research vessel for satellite validation, aerosols, etc.
A Preliminary Plan for the 2011 Indian Ocean Field Experiment

R/V MIRAI
Kadhdhoo
Hulhule
R/V Ron Brown
HARIMAU
Manus

R/V MIRAI